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ELECTROMAGNETIC CONDUCTIVE FLUID PUMP

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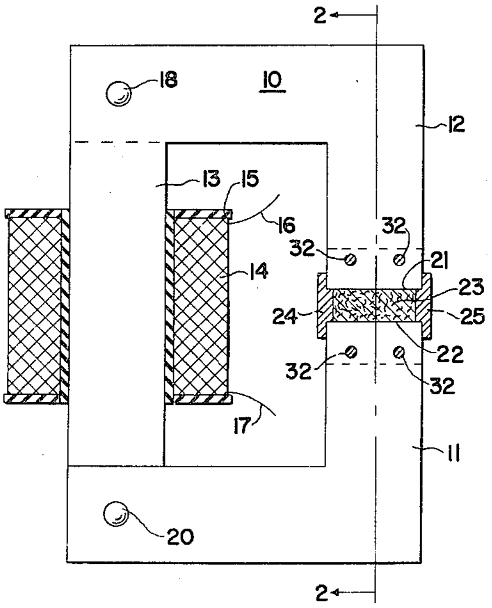

FIG. 1

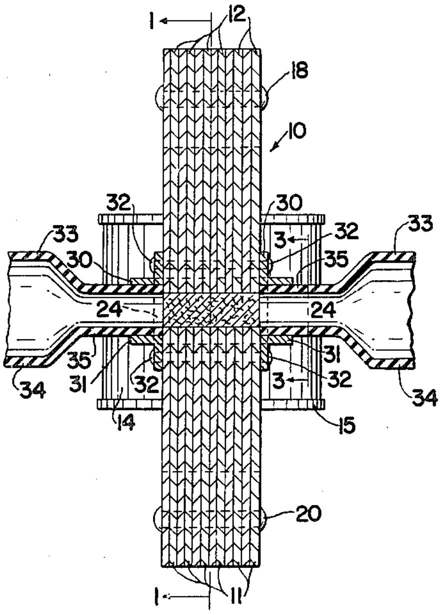

FIG. 2

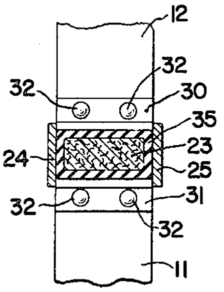

FIG. 3

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# ELECTROMAGNETIC CONDUCTIVE FLUID PUMP

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**6 Claims. (Cl. 103—1)**

This invention relates to electromagnetic conductive fluid pumps and more specifically relates to a pump having a porous material as its pumping channel. Electromagnetic fluid pumps have been long known in the art and are often referred to as Faraday pumps. In their usual form, they comprise a non-conductive tube filled with a conductive fluid which passes through a magnetic field. Inserted in the sides of the tube at right angles to the magnetic field are two electrodes which act to conduct a current through the magnetic field by means of the fluid in the tube. When the current and the magnetic field are in phase with each other and at substantially right angles, a force mutually perpendicular to the current and field is created in the fluid. This force acts to propel the fluid in the tube in the manner of a usual type of pump.

An object of the present invention is to disclose an electromagnetic fluid pump that has a unique configuration for the pumping channel or gap.

A further object is to disclose an electromagnetic pump that has a large opening in its magnetic structure without the normally encountered high magnetic reluctance.

These and other objects will become apparent when the following description is considered with the single sheet of drawings, wherein:

Figure 1 is a cross-sectional side view of the novel pump along lines 1—1 of Figure 2;

Figure 2 is a cross-section of a leg of the pump along lines 2—2 of Figure 1, and;

Figure 3 is a partial view of the pumping channel along lines 3—3 of Figure 2.

A C-shaped magnetic structure generally disclosed as **10** is formed of two L-shaped laminations **11** and **12**. The laminations **11** and **12** are formed such that by alternately arranging the stacking of the laminations a complete C-shaped structure **10** is formed. On the center leg **13** of the structure **10** is placed a coil **14** which is wound on an insulated bobbin **15**. The coil **14** has two electrical leads **16** and **17**. The coil **14** is preferably pre-wound on the bobbin **15** and the bobbin **15** is inserted on the leg **13** while the laminations **11** and **12** are being assembled. Two rivets **18** and **20** are utilized to clamp the stacks of laminations **11** and **12** into a substantially solid magnetic structure.

The laminations **11** and **12** of the C-shaped structure **10** provide two opposing poles **21** and **22** which define an air gap into which is placed a porous material **23**. The porous material **23** is normally of a magnetic material such as a sintered ferrite. The porous material **23** substantially fills the air gap created between poles **21** and **22** and acts to reduce the magnetic reluctance of the air gap as well as provide a channel means, as will be seen in the subsequent description. It is further understood that porous material **23** may be in any form, such as granular or solid, as long as its is pervious to the conductive fluid to be used. Placed on opposite sides of the porous material **23** are two electrodes **24** and **25**. The electrodes **24** and **25** seal the sides of the pole faces **21** and **22** in a fluid tight fashion and are in direct contact with the porous material **23**. The areas of contact between the electrodes **24** and **25** and the poles **21** and **22** is insulated by means of a varnish or other type of insulating sealant. Support brackets **30** and **31** are attached by means of rivets **32** to the poles **21** and **22** of the magnetic structure **10** to form a support for an insulated conduit **33**. The rivets **32** not only act to hold the brack~~ets **30** and~~ **31** in place but also act to clamp the laminations **11** and **12** into a substantially solid mass.

The conduit **33** is formed from a material having an annular section **34** which is reduced to a rectangular cross-section **35**. The rectangular cross-section **35** is inserted into the brackets **30** and **31** and are sealed therebetween by any convenient means. The sides of electrodes **24** and **25** fall adjacent the opposite sides of the rectangular section **35** and thereby form a fluid type seal at each of the opposite sides of the porous material **23** adjacent to the poles **21** and **22**. It is further understood that conduit **33** could be constructed of a metallic member as long as the resistance of the metal used was high in comparison to the resistance between electrodes **24** and **25** through the porous material **23** when it contains the conductive fluid which is to be pumped. In the simplest application however, a non-metallic conduit **33** is utilized and can be constructed of a material such as plastic or glass.

With the construction described above a continuous fluid passage is established by means of conduit **33**, a sealed junction formed of the brackets **30**, **31**, and electrodes **24** and **25**. This conduit passes through the porous material **23** into the second part of the conduit **33** which has the same sealed junction as the first section described. Any conductive fluid placed in one end of conduit **33** passes through the porous material **23** between electrodes **24** and **25** out into the other end of conduit **33**. If the coil **14** is energized a magnetic field will be established across the poles **21** and **22** and the conductive fluid therefore will be under the influence of this magnetic field. When a sintered ferrite is used for the porous material **23** it is understood that the magnetic field established across the poles **21** and **22** is large enough to saturate the ferrite and thereby a leakage flux exists across the voids which exist in the porous material **23**. The magnetic flux existing in these voids operates in conjunction with a current which is supplied to electrodes **24** and **25**, by means not shown. The current flows from one electrode to the other is at right angles to the direction of flux. This combination of flux and current creates a force in the conductive fluid which impels the conductive fluid in the porous material **23** in a direction mutually perpendicular to the direction of the current and flux. By this arrangement the electromagnetic conductive fluid pump is caused to operate.

It is further understood that the coil **14** and the laminated structure **10** could be replaced by a permanent magnet having the same C-shaped type of configuration for a direct current type pump. Also the device could be modified by utilizing a continuous tube or conduit in place of conduit **33**. If a continuous conduit is utilized and is placed in the gap created by poles **21** and **22** the porous material **23** is inserted therein at a point which would coincide with the location of the above mentioned poles. Electrodes can then be inserted into the sides of the conduit or welded or soldered with a compatible solder to the outside depending on the type of construction desired. All of these constructional details are familiar to those versed in the art and will not be described in further detail here.

By the construction disclosed, the fluid passing through the porous material **23** has a large area of surface contact and this large area of surface contact allows for the flow of the necessary current between electrodes **24** and **25**. This arrangement further allows for the use of a wide gap in the magnetic structure **10** but yields an electromagnetic conductive fluid pump which has the characteristic of a narrow gap type pump. Many modifications in the types of material and physical configurations could be utilized with the teachings disclosed presently, and it is understood that the applicant wishes therefore to be limited only by the scope of the appended claims.

I claim as my invention:

1. In an electromagnetic pump of the class described wherein a conductive fluid is caused to flow by an electric current and a magnetic field angularly disposed to each other and to the direction of flow of the fluid: a magnetic circuit including said magnetic field; said magnetic circuit further having an opening therethrough; conduit means having a portion thereof disposed in said opening; said portion being substantially filled with a porous material and said porous material transmitting the magnetic field across said opening; and electrode means adjacent to opposite sides of said porous material to conduct the flow of said electric current mutually perpendicular to said field and fluid flow; said current and magnetic field causing the conductive fluid to move through the porous material and thereby propel said conductive fluid in said conduit.

2. In an electromagnetic pump of the class described wherein a conductive fluid is caused to flow by an electric current and a magnetic field angularly disposed to each other and to the direction of flow of the fluid: a magnetic circuit including said magnetic field; said magnetic circuit having an opening therethrough; a porous material substantially filling said opening and transmitting the magnetic field across said opening; fluid conduction means adjacent opposite sides of said porous material to contain said conductive fluid; and electrode means adjacent to the other opposite sides of said porous material to conduct the flow of said electric current mutually perpendicular to said field and fluid flow; said current and magnetic field causing the conductive fluid to move through the porous material and to thereby propel said conductive fluid.

3. In an electromagnetic pump of the class described wherein a conductive fluid is caused to flow by an electric current and a magnetic field angularly disposed to each other and to the direction of flow of the fluid: a magnetic circuit into which is induced said magnetic field; said magnetic circuit having an opening therethrough; a porous material substantially filling said opening and transmitting the magnetic field across said opening; fluid conduction means adjacent opposite sides of said opening to contain said conductive fluid; and electrode means adjacent to the other opposite sides of said opening to conduct the flow of said electric current mutually perpendicular to said field and fluid flow; said current and magnetic field causing the conductive fluid to move through the porous material and to thereby propel said conductive fluid.

4. In an electromagnetic pump of the class described wherein a conductive fluid is caused to flow by an electric current and a magnetic field angularly disposed to each other and to the direction of flow of the fluid: a C-shaped magnetic circuit having a magnetic field induced therein; conduit means having a portion thereof disposed in the opening of said C-shaped magnetic circuit; said portion being substantially filled with a porous magnetic material and said porous material transmitting the magnetic field across said opening; and two electrodes adjacent to opposite sides of said porous material to conduct the flow of said electric current mutually perpendicular to said field and fluid flow; said current and magnetic field causing the conductive fluid to move through the porous material and thereby propel said conductive fluid in said conduit.

5. In an electromagnetic pump of the class described wherein a conductive fluid is caused to flow by an electric current and a magnetic field angularly disposed to each other and to the direction of flow of the fluid: a C-shaped magnetic circuit into which is induced said magnetic field; a porous magnetic material substantially filling the opening of said C-shaped magnetic circuit and transmitting the magnetic field across said opening; fluid conduction means adjacent opposite sides of said opening to contain said conductive fluid; and electrodes adjacent to the other opposite sides of said opening to conduct the flow of said electric current mutually perpendicular to said field and fluid flow; said current and magnetic field causing the conductive fluid to move through the porous material and to thereby propel said conductive fluid.

6. In an electromagnetic pump of the class described wherein a conductive fluid is caused to flow by an electric current and a magnetic field angularly disposed to each other and to the direction of flow of the fluid: conduit means having a portion thereof disposed in said magnetic field; said portion including a porous material; and electrode means adjacent said porous material to pass said electric current therethrough; said current and magnetic field causing the conductive fluid to move through the porous material and thereby propel said conductive fluid in said conduit means.

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